



# FrankenCIS Microsquirt Manual supplement

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# FrankenCIS

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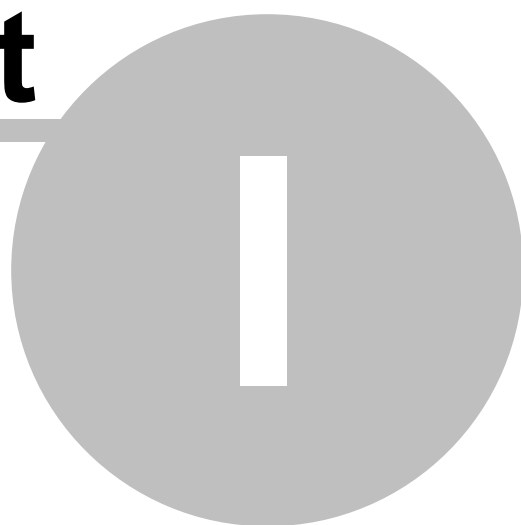
*Steve*

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# Part

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# 1 Introduction

FrankenCIS is a software and hardware project to allow the MegaSquirt family of engine controllers to replace the Bosch WUR or control the DPR/EHA valve on later systems.

In its simplest implementation - mimicking the WUR by a temperature to bar map and closed loop pressure control. With optional interceptor like +- control of fuel mixture using the full mapping abilities of the MegaSquirt family.

More advanced implementations - the sky is the limit really, Spark and Idle control, Full fuel mapping, Closed loop wideband O2 control, Boost enrichment and or pressure control, and so on.

This document should be used in conjunction with the Microsquirt Hardware Manual available from MSEXTRA.COM ( <http://www.msextra.com/manuals/ms2manuals/> )

How are we doing it?

We have created a new firmware or operating system based on the MS2extra code and MegaSquirt hardware which retains all the relevant EFI tuning, spark control and accessory features, but when switched into one of the K-Jet / CIS modes completely changes the way it interacts with the fuel side of the system.

- K-Jetronic basic - controls an electronic WUR block by targeting a control pressure map referencing Time/Temperature. MS2Extra firmware has been modified to change a "Squirt per Rev" to mapped fuel pressure control on Injector1. The target pressure is taken from a new map representing the WUR basic bar/temp curve and then modified by percentage according to changes in the remaining tuning options. The standard style EFI Load and RPM referenced fuel demand map is then mixed in on top to provide an enhanced version of the manifold pressure adjustment available in the standard mechanical WUR.
- K-Jetronic Lambda - as above with the addition of a second map table controlling the Frequency Valve or equivalent. in this mode we also split the additional EFI style tuning features between the WUR and FV where appropriate.
- KE-Jetronic - completely different to the first two, No WUR, No Frequency Valve, static control pressure and complete control of the differential pressure between the top and bottom chambers of the Fuel Distributor. This option requires a small interface module between the DPR (sometimes called EHA) and the MicroSquirt to convert the injector control signals.

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**WARNING:**

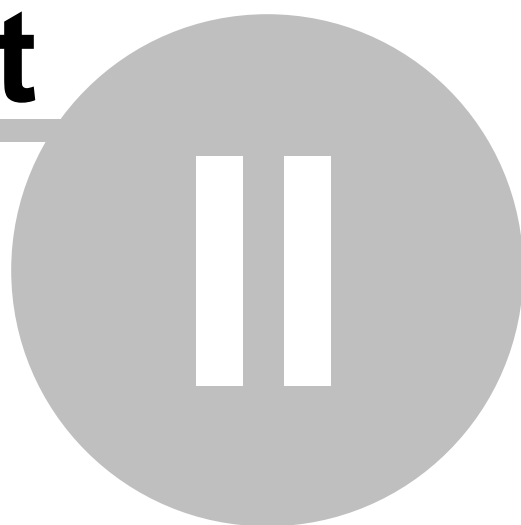
This installation is not for the tuning novice! Use this system with EXTREME caution!

FrankenCIS allows for total flexibility in engine tuning. Misuse or improper tuning of this product can destroy your engine! If you are not well versed in engine dynamics and the tuning of engine management systems DO NOT attempt the installation. Refer the installation to an FrankenCIS-trained tuning shop or call +61 7 3256 5600 for technical assistance.

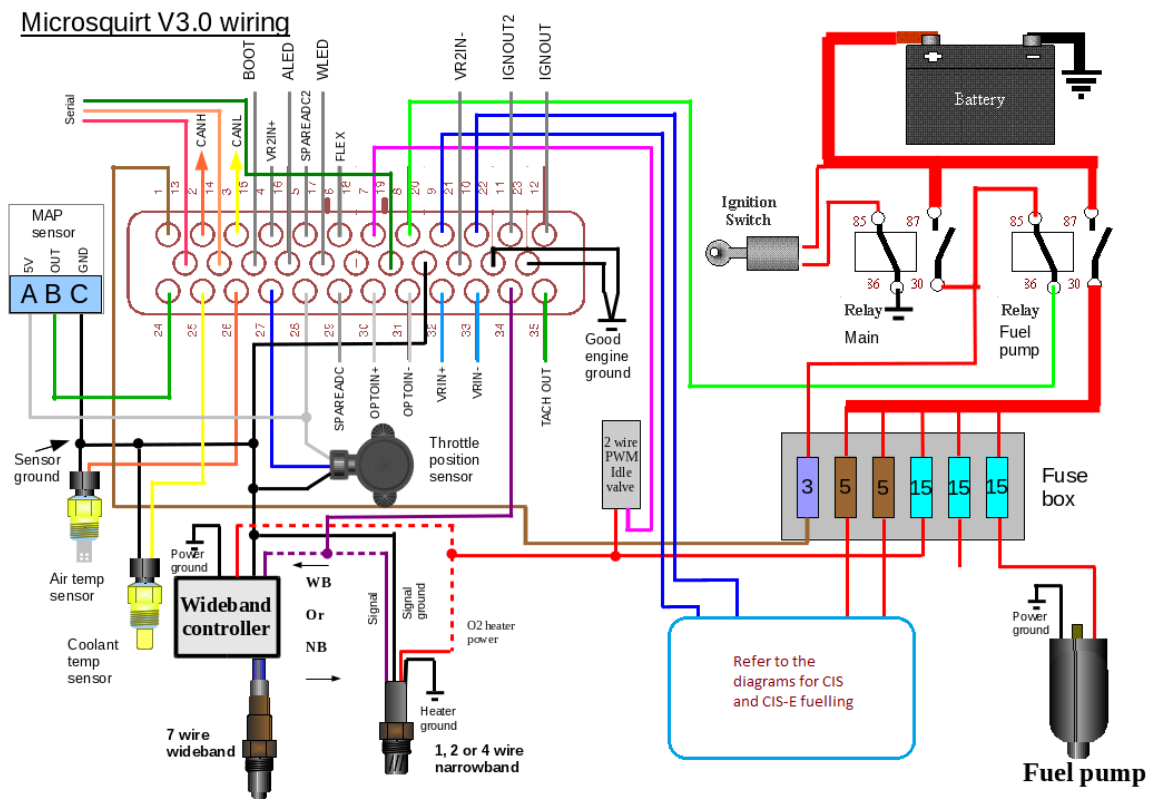
NOTE: All supplied FrankenCIS calibrations, Wizards and other tuning information are offered as potential starting points only. IT IS THE RESPONSIBILITY OF THE ENGINE TUNER TO ULTIMATELY CONFIRM IF THE CALIBRATION IS SAFE FOR ITS INTENDED USE. FrankenCIS holds no responsibility for any engine damage that results from the misuse or mistuning of this product!

# Part

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## 2 Wiring



General system wiring overview above. Individual installations may vary.

Fuelling and Spare ADC connections to the control pressure sensor will depend on the version of CIS and FrankenCIS components installed.

The throttle position sensor can be ignored or added if required for CIS and would normally be connected to the Air Plate Potentiometer in CIS-E installations.

Spark and Idle control outputs are optional etc.

Pin#	Name	Color	In/Out	Function	Max current
1	+12V In	Red	In	Main power feed	< 1A
2	CANH	Blue/Yellow	Comms	CAN communications	-
3	CANL	Blue/Red	Comms	CAN communications	-
4	VR2+	VR2	In	'Cam' tach in	-
5	SPAREADC2 (MAF)	Pink/Black	In	Spare analogue input	-
6	FLEX	Purple/White	In	Flex / spare input	-
7	FIDLE	Green	Out	Idle valve output	3A
8	FP (pump)	Purple	Out	Fuel pump relay output	3A



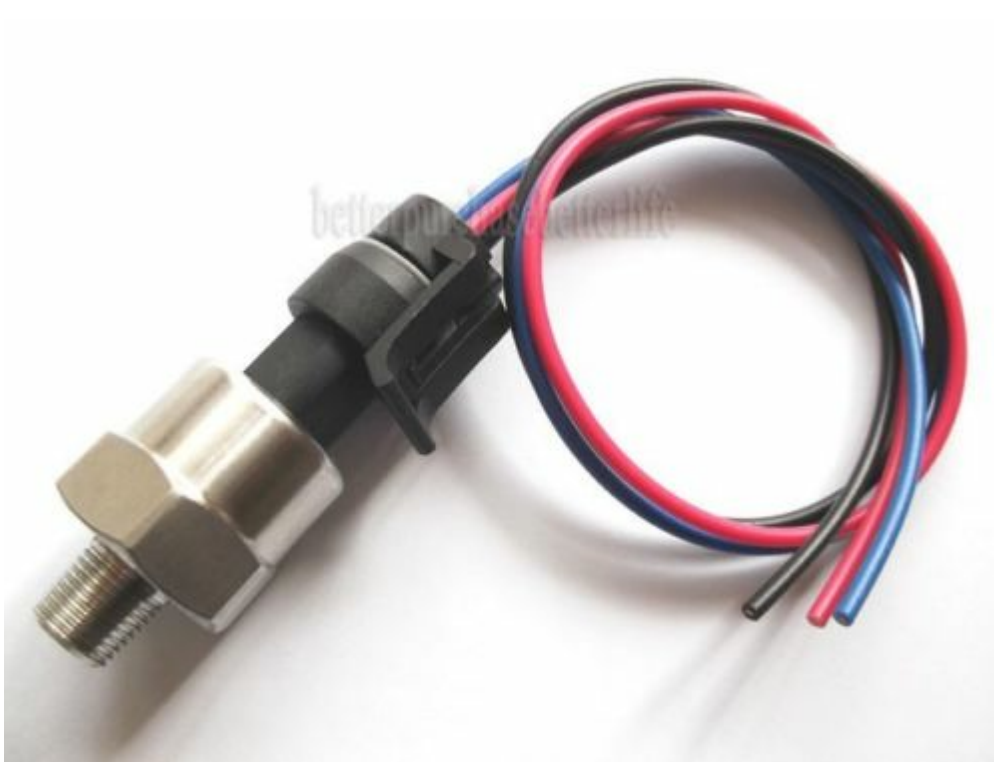
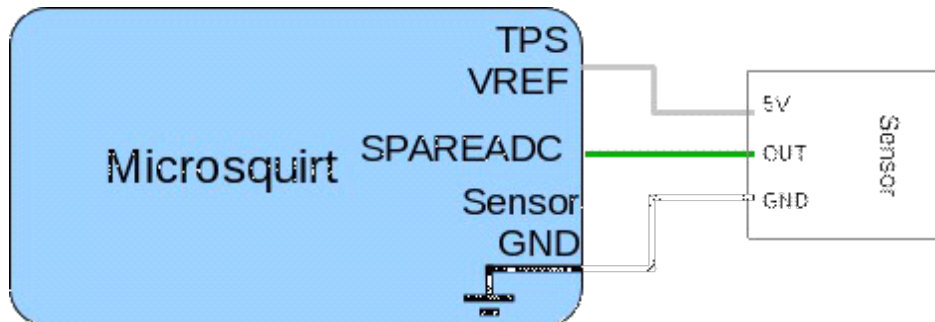
9	FUEL A	Thick Green	Out	FrankenCIS or DPR 5	5A
10	FUEL B	Thick Blue	Out	Frequency Valve or DPR 2	5A
11	SPK B (IGN2)	Thick White/Red	Out	Spark B logic output	0.02A
12	SPK A (IGN 1)	Thick White	Out	Spark A logic output	0.02A
13	RX	-	Comms	RS232 communications	-
14	TX	-	Comms	RS232 communications	-
15	BOOT LOAD	Purple/Black	In	Bootloader enable input	-
16	ALED	Yellow/Black	Out	Spare relay output	3A
17	WLED	Yellow/White	Out	Spare relay output	3A
18	Sensor Ground	-	GND	Not installed	-
19	Serial Ground	-	GND	Serial Ground	-
20	Sensor Ground	White/Black	GND	Sensor Ground	-
21	VR2-	VR2	In	'Cam' tach in	-
22	POWER GROUND	Thick Black	GND	POWER GROUND	-
23	POWER GROUND	Thick Black	GND	POWER GROUND	-
24	MAP	Green/Red	In	MAP sensor input	-
25	CLT	Yellow	In	CLT sensor input	-
26	MAT	Orange	In	MAT sensor input	-
27	TPS	Blue	In	TP Sensor input	-
28	TPS VREF (5V)	Gray	Out	5V supply for TPS	0.1A
29	CONTROL PRESSURE	Orange/Green	In	Control Pressure Sensor	-
30	OPTO+	Grey/Red	In	Coil negative tach in	-
31	OPTO-	Grey/Black	In	Coil negative tach in	-
32	VR1+	VR1	In	'Crank' tach in	-
33	VR1-	VR1	In	'Crank' tach in	-
34	O2	Pink	In	Oxygen/lambda sensor in	-
35	TACHO	Green/Yellow	Out	Tacho / rev counter out	0.3A

## 2.1 3.4.9 Spare ADC / Control Pressure

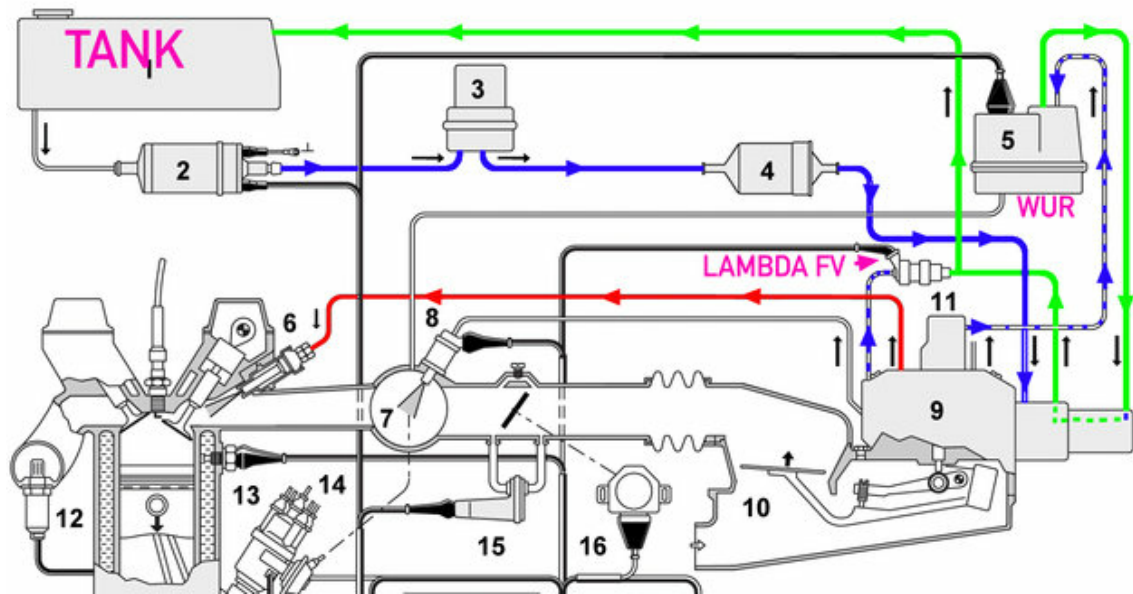
Spare ADC is Pin 29 - Orange / Green on the MicroSquirt

The SPAREADC input is used for Control Pressure Measurement for CIS installations and can also be utilized as a lower chamber pressure monitor in CIS-E installs

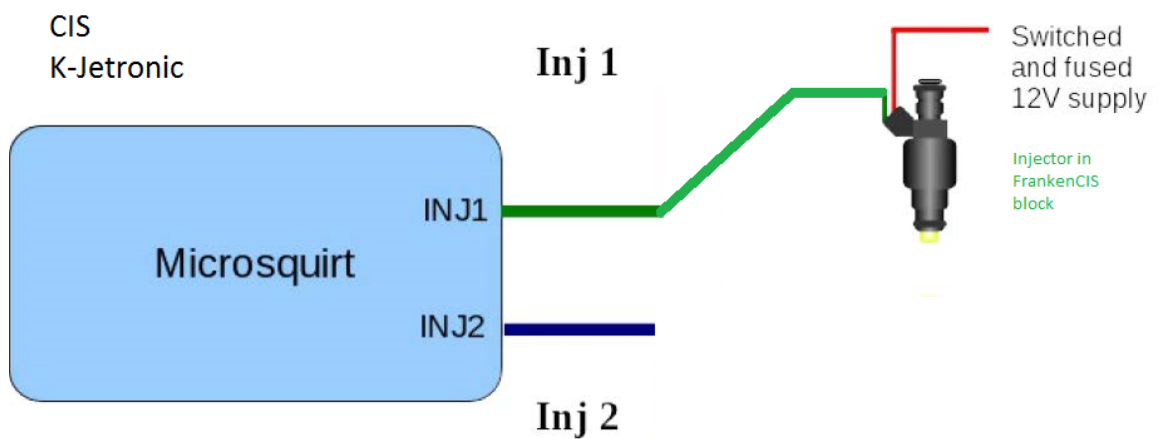
Fitted either in line or directly to the FrankenCIS metering block, the fuel pressure sensor in the control pressure circuit provides actual Control Pressure in kPa and is used in the Target Pressure feedback loop calculations within the MicroSquirt.

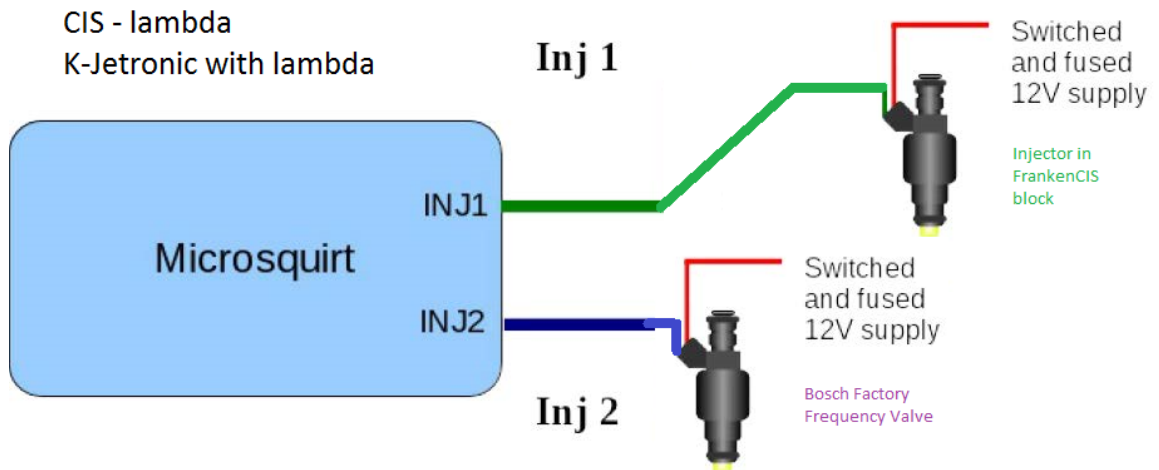


## 2.2 4 Fuel System - CIS

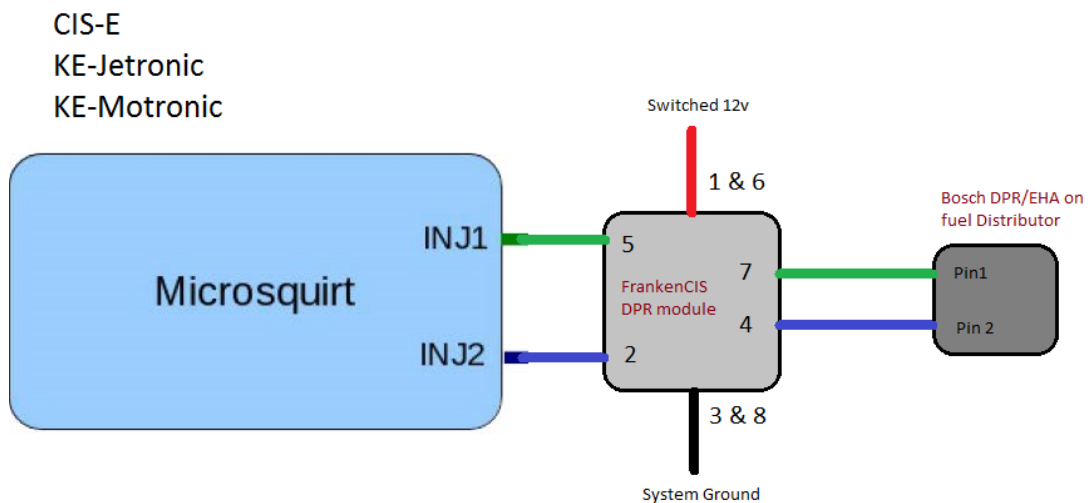


FrankenCIS replaces the Bosch Warm Up Regulator at 5, and optionally controls the Frequency Valve at 11



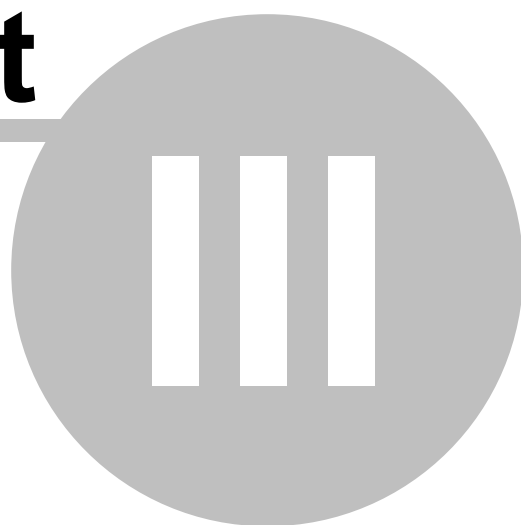


## 2.3 4 Fuel System - CIS-E



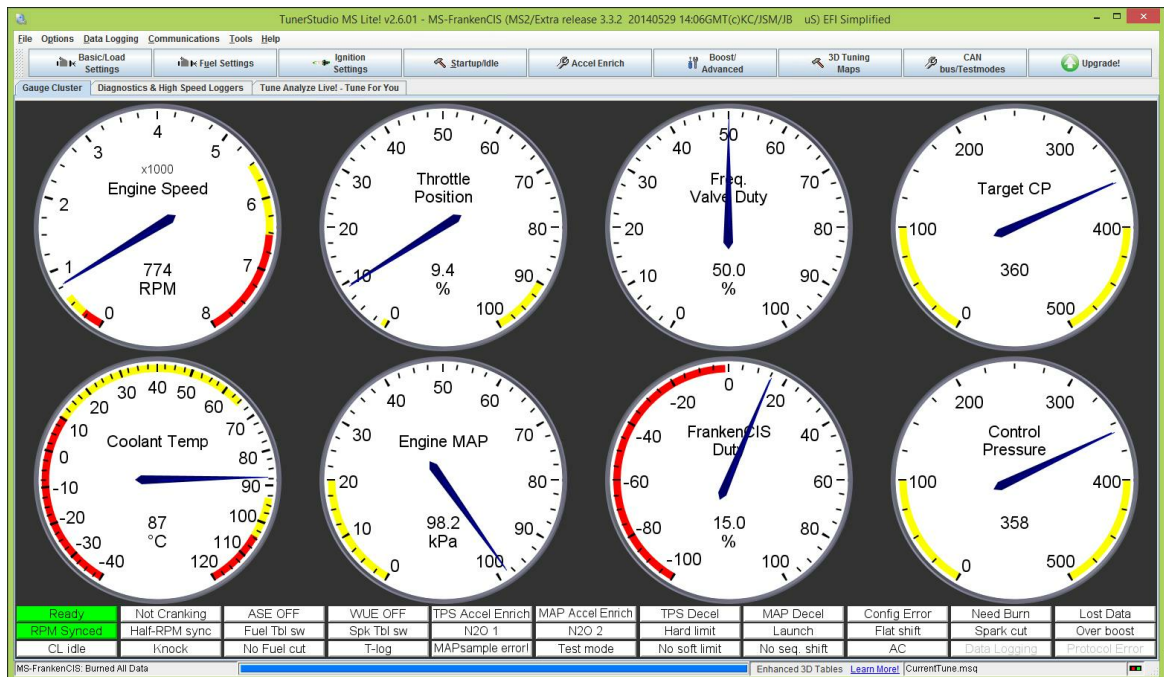
# Part

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### 3 System Setup and Tuning

After loading the project and connecting to the microsquirt as per the main manual, the screen should look similar to the following



Under Engine and Sequential settings, the Injector Port Type must be set to correctly match the FrankenCIS system installed, and the number of cylinders should match the target motor. The remaining settings should reflect the installation configuration with a couple of exceptions

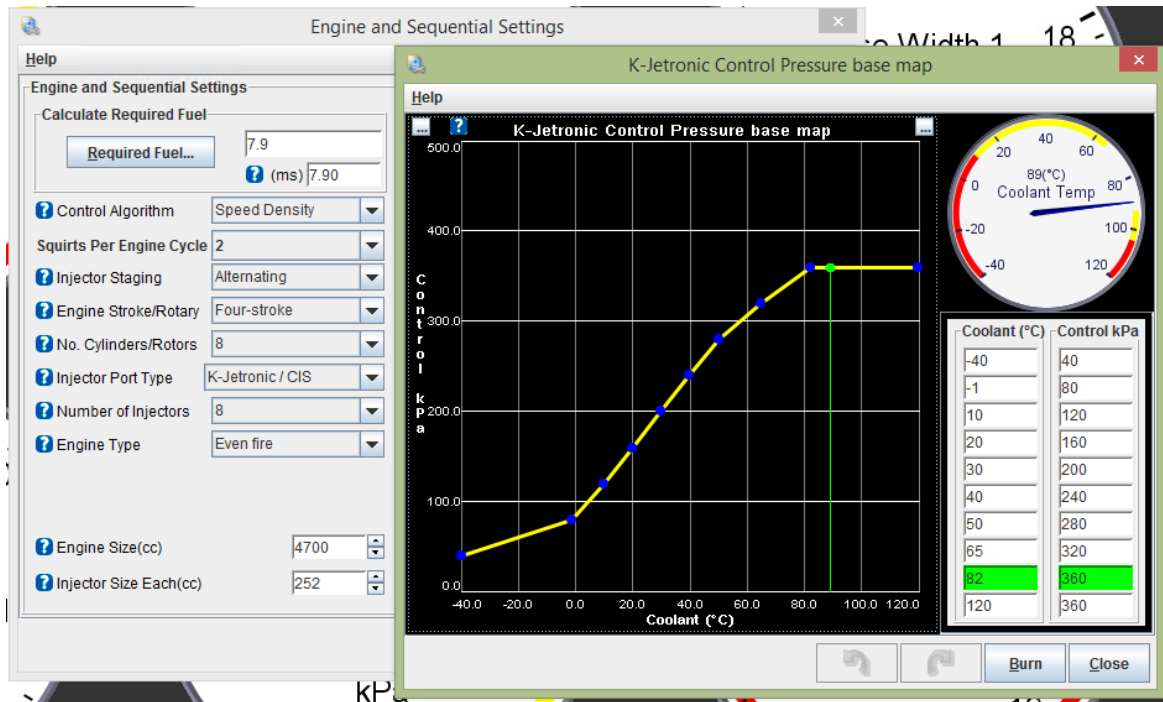
Squirts per engine cycle is now irrelevant but should be left at 2 or 'constant' if available  
 Injector size is also no longer a real value but should be close to the estimated fuel flow per injector if known otherwise 252 is a good number

If doing an install with the FrankenCIS eWUR then refer to the CIS with WUR section

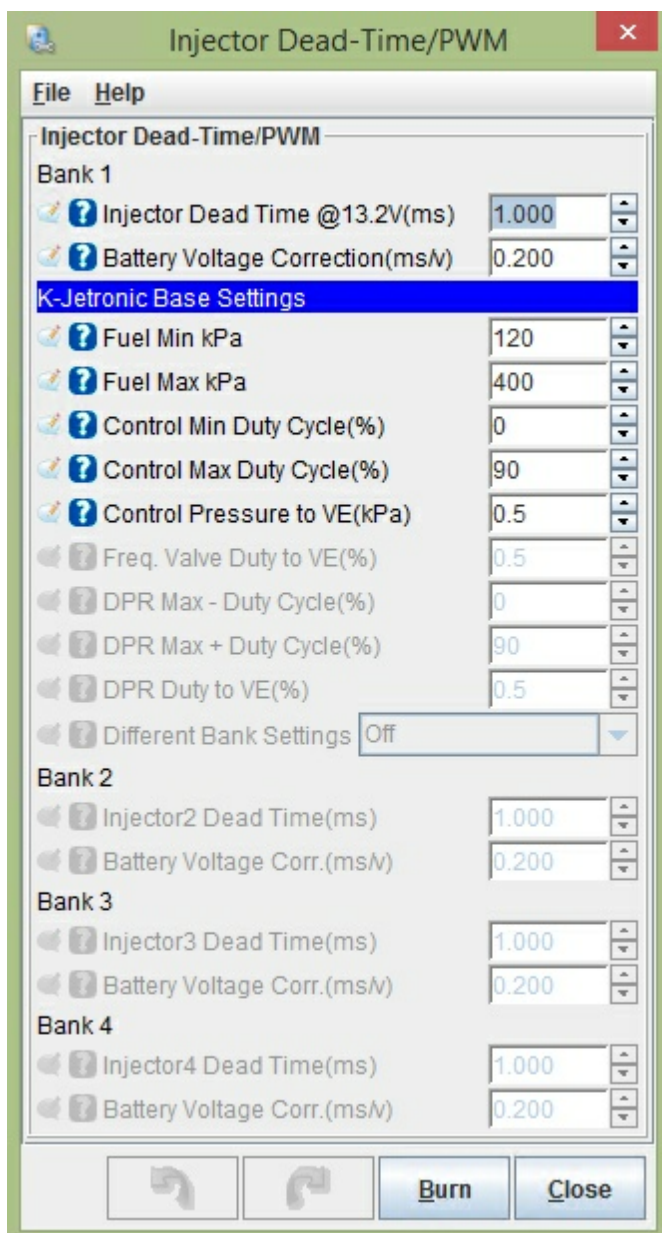
If doing an install with the FrankenCIS DPR Interface then refer to the CIS-E section

Throughout the system click or mouse over the blue question mark for an explanation of the setting

### 3.1 - CIS with WUR



Injector Dead Time PWM contains some FrankenCIS specific settings for range and resolution



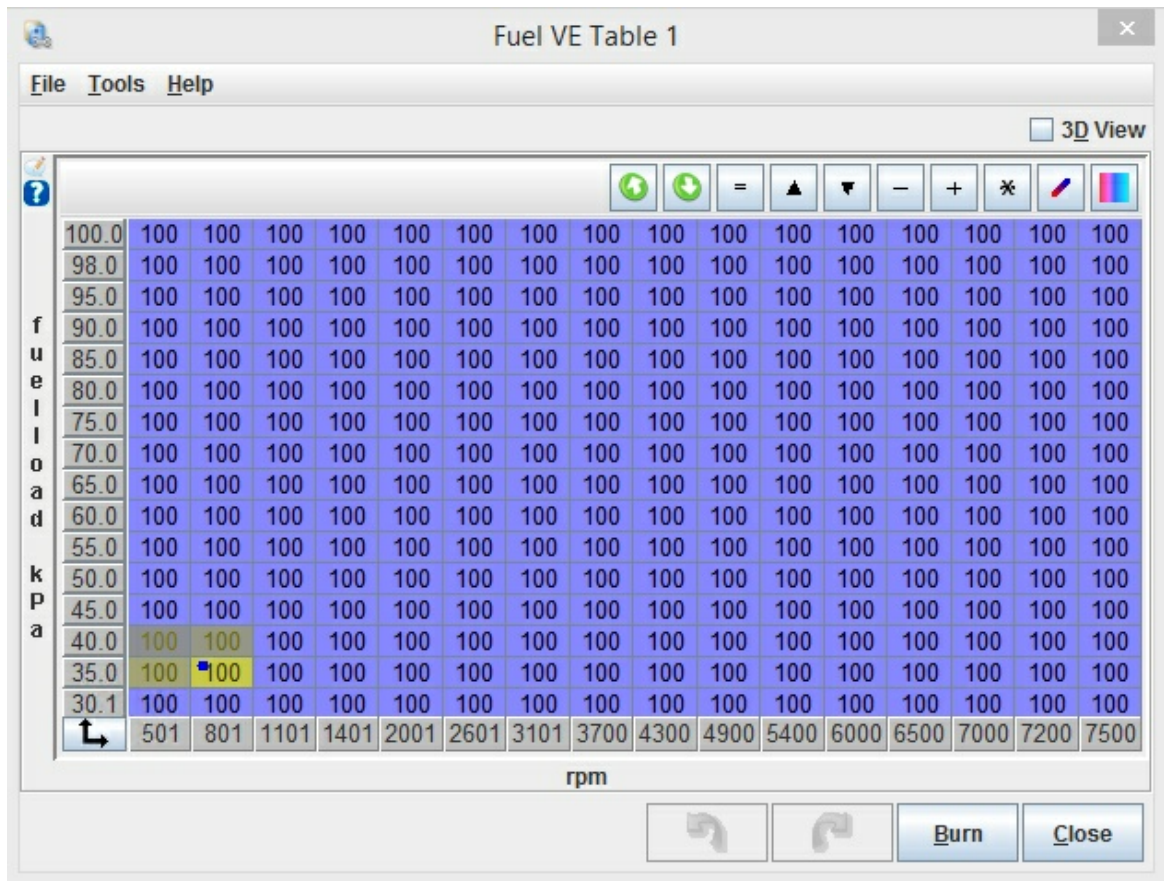
The starting point for the settings above can be adjusted to suit your installation

The kPa to VE factor. how many kPa to 1 point (0.1%) of VE

The system converts a desired VE change to target kPa change using this multiplier

VE tables are the main point of adjustment for the running fuel trim and should begin as a flat 100 across all cells





If set to the Lambda version and Inj2 is properly connected to the factory Frequency Valve then a second VE table is available by turning on Dual Table Use in General Settings

VE Table 1 has control of the eWUR

VE Table 2 has control of the Frequency Valve

This gives individual control of both systems

## 3.2 - CIS-E

**Engine and Sequential Settings**

File Help

**Engine and Sequential Settings**

**Calculate Required Fuel**

Required Fuel... 15.5  
 ? (ms) 15.50

**Control Algorithm** Speed Density

**Squirts Per Engine Cycle** 2

**Injector Staging** Alternating

**Engine Stroke/Rotary** Four-stroke

**No. Cylinders/Rotors** 8

**Injector Port Type** KE-Jetronic / DPR 100hz

**Number of Injectors** 8

**Engine Type** Even fire

**Engine Size(cc)** 2000

**Injector Size Each(cc)** 0

**Sequential Injection**

Sequential Injection Untimed injection

Timing Trigger Start-of-pulse

Fixed Timing Or Table Fixed Timing

Number Of Timing Values Single value

Fixed Injection Timing 1(deg) 90.0

Fixed Injection Timing 2(deg) 270.0

Fixed Injection Timing 1 When Staging On(deg) 90.0

Fixed Injection Timing 2 When Staging On(deg) 270.0

Cranking Injection Timing 1(deg) 90.0

Cranking Injection Timing 2(deg) 270.0

VE Trim Tables Don't use VE Trim Tables

Injector Drivers Standard drivers

**Sequential Siamese Hybrid Mode**

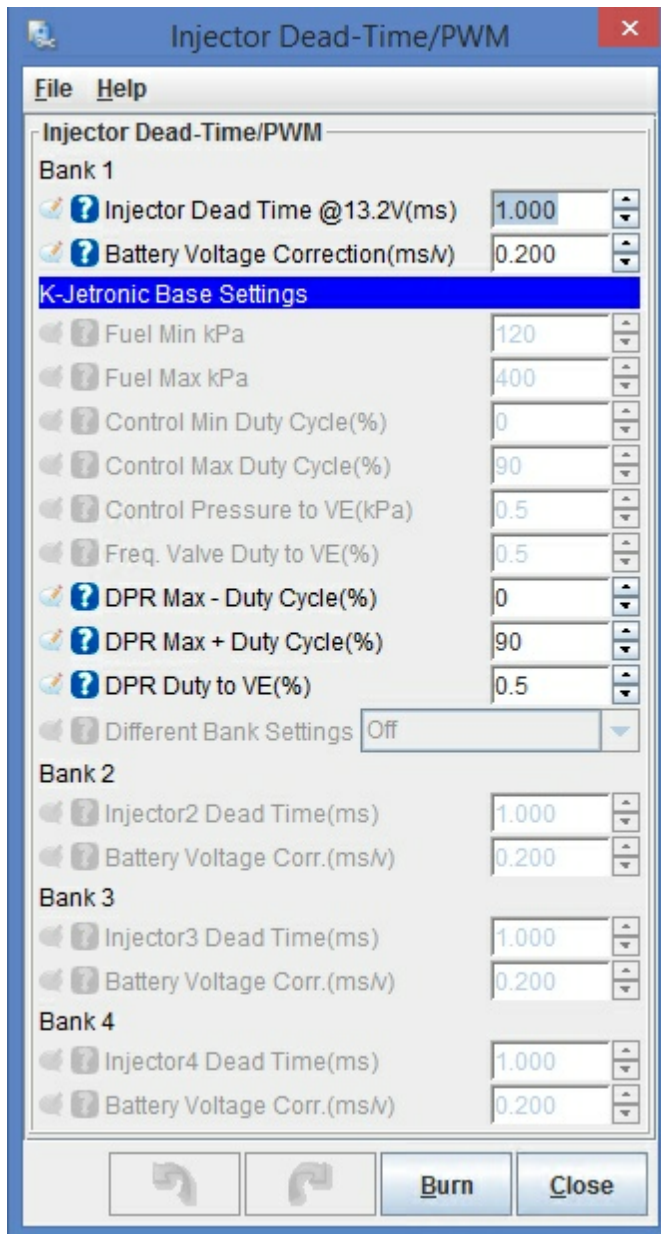
Single Pulse Activation RPM 15000

Hysteresis On Single Pulse Activation RPM 100

Fixed Injection Timing 3(deg) 90.0

Fixed Injection Timing 3 When Staging On(deg) 90.0

Back Previous Burn Close

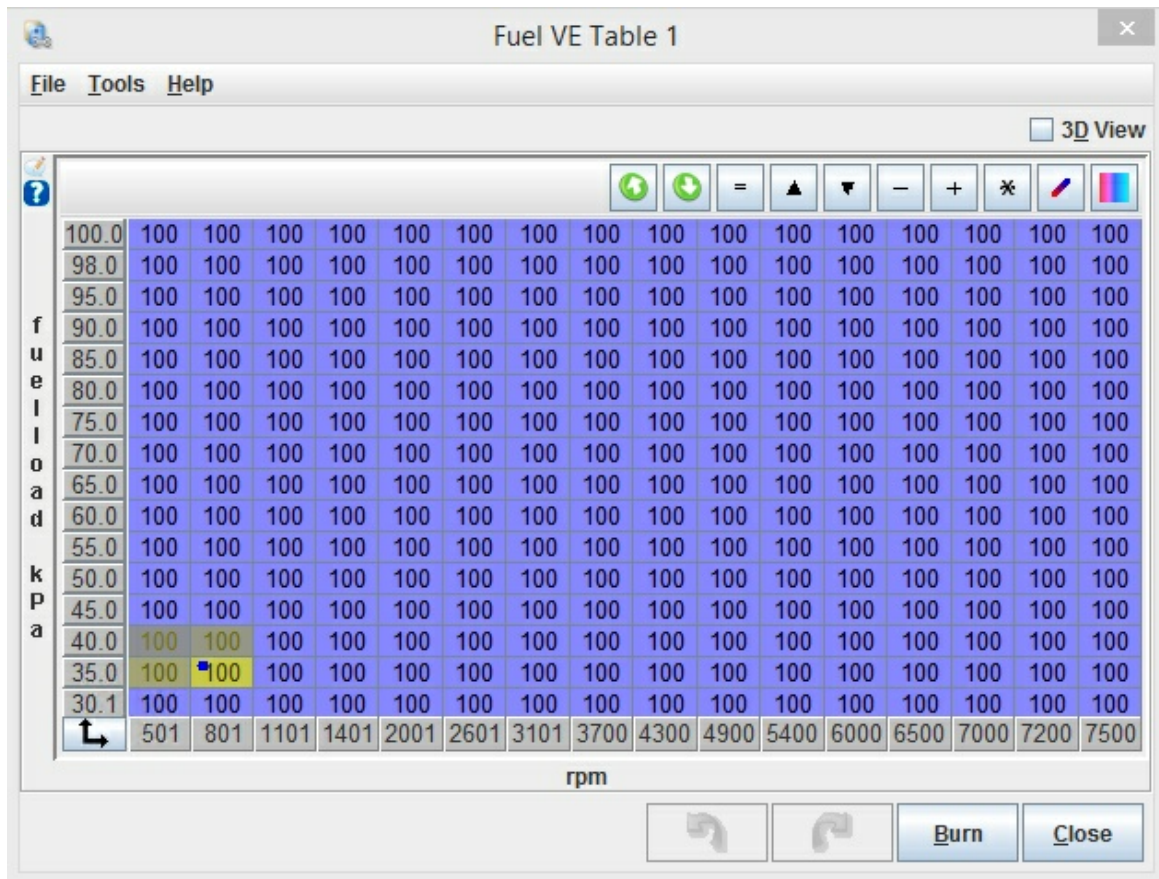


The starting point for the settings above can be adjusted to suit your installation

The Duty to VE factor. PWM duty cycle to 1 point (0.1%) of VE

The system converts a desired VE table and EGO change to target PWM Duty change using this multiplier

VE tables are the main point of adjustment for the running fuel trim and should begin as a flat 100 across all cells



The CIS-E systems have two main variants and the center point or tuning offset for the DPR/EHA varies depending on the system.

the early KE generally has a light grey DPR or EHA valve and is usually set to operate positive duty cycle bias requiring a current of around 20ma at idle which might be 120 or so in the map depending on the ration chosen in the settings.

the later KE3 or KE-Motronic is usually a black DPR/EHA and is usually happy with a centre point of 0-6ma which would be 100 in the maps

This gives individual control of both systems, but means startup values will vary by install depending on the system in place and whether or not the DPR has been previously adjusted manually via the little trim screw

If you chose - either type of DPR can be manually adjusted to provide a slightly positive bias around 100 in the maps so an electrical control failure will provide the same "Limp Home" capabilities as the late CIS-E

### 3.3 Idle Valve

The factory rotary Idle valve seems to be happy with the following settings  
make sure it is fitted with the flyback diode as mentioned in the main manual  
1n4001 as recommended



**Idle Control**

File Help

**Idle Control**

Idle Valve Type: PWM valve (2 or 3 wire)

Algorithm: Open-loop (warmup)

**Stepper idle**

Time Step Size(ms): 3

Initial Time Step Size(ms): 5

Minimum # Steps To Move(steps): 1

Homing Steps: 160

Homing Direction: Closed

Wide Open Steps(steps): 200

Crank-to-Run Taper Time(s): 5

Hysteresis( $i_L$  %C): 2.8

Connection: Off

Power Between Steps: Hold current

**PWM Idle**

Fast Idle Temperature( $i_L$  %C): 60.0

Hysteresis( $i_L$  %C): 2.8



Crank-to-Run Taper Time(s): 3

Valve Mode: Normal, 0%=off

Run Valve Before Start: Off

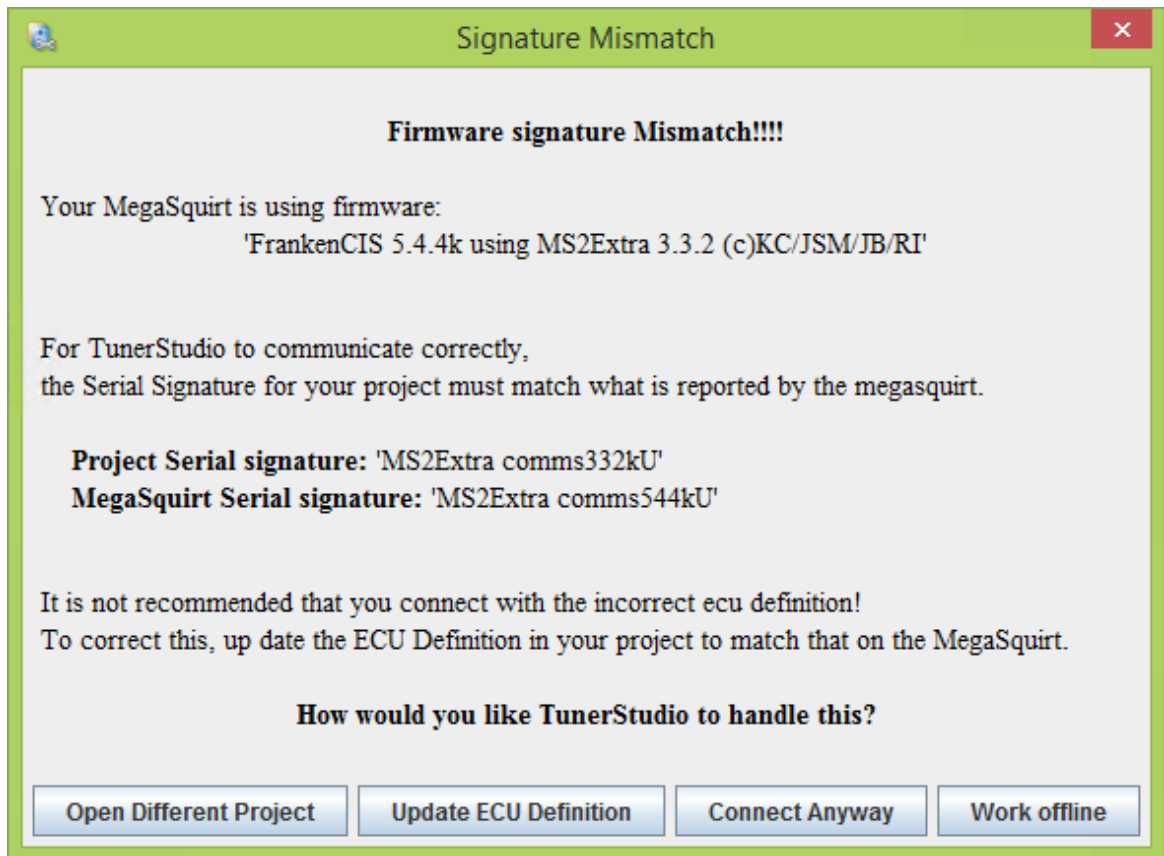
PWM Idle Port: FIDLE

Valve Frequency: 153Hz

Buttons:   Burn Close

### 3.4 Firmware

When updating firmware the following dialog will show on connection to the system



Select Update ECU Definition, it will then allow you to browse and select the appropriate .ini file for your ECU

e.g. microsquir.ini

### 3.5 Spartan2 Wideband Setup

Install and wire up spartan 2 according to the user manual

In Tuner Studio, tools->Calibrate AFR Table->EGO Sensor select "Custom Linear WB", enter the values shown in the picture below and write changes to MegaSquirt.



Later on we will change the Custom Linear WB settings to account for offset and linear errors.

During powerup Spartan 2's Output Sequencer will be triggered, the output sequencer will output 2 distinct calibration voltages on the Linear Output, 1.666 volts for the first 5 seconds then 3.333 volts the next 5 seconds, after 10 seconds has passed then the Linear Output will function normally. When a wideband controller is first powered up, it will take about 30 seconds to 1 minute for the Wideband Oxygen Sensor to heat up, while the sensor is heating up the Wideband sensor is unable to read the AFR of the exhaust gas composition, only when the sensor is heated up will the AFR of the exhaust gas composition be correct. Spartan 2's Output sequencer takes advantage of this heatup time when the AFR data is not correct to output calibration voltages that we will use to generate new

Tuner Studio settings to compensate for offset and linear errors.

While Tuner Studio is running and is actively displaying AFR data, cycle power to Spartan 2 and write down the 2 AFRs shown by tuner studio during the first 5 seconds and then during the next 5-10 seconds. For this example lets use 13 AFR and 17.1 AFR. Now if there were no offset or linear errors present the first 5 seconds AFR should be 13.328 AFR and the 5-10 seconds AFR should be 16.666 AFR.

Now download and open this Microsoft excel worksheet [here](#)

Input		
AFR Conversion Factor	14.7	
	AFR shown by MS	Ideal AFR
first 5 seconds	13	13.328
5-10 seconds	17.1	16.66
Calculated		
Calculated Slope Compensation	0.812682927	
Calculated Offset Compensation	2.763121951	
Enter this into Tuner Studio		
	Volts	AFR
Point 1	0	10.88995122
Point 2	5	19.01678049

Assuming that the first 5 seconds AFR shown by Tuner Studio is 13 AFR and the 5-10 seconds AFR shown by tuner studio is 17.1 AFR, you would enter 13 and 17.1 into the excel worksheet like the above picture, of course instead of 13 AFR and 17.1 AFR you would enter the AFR shown by your Tuner studio. Once those two AFRs are entered, the settings in the green box will be calculated to compensate for offset and linear errors, this calculated setting you will enter into Tuner

Studio and you MegaSquirt will be able to read AFRs from Spartan 2 with an accuracy of 1/10th of an AFR.

In Tuner Studio, tools->Calibrate AFR Table->EGO Sensor select "Custom Linear WB", enter the values shown in green excel worksheet and write changes to MegaSquirt. In my example where the first 5 seconds AFR is 13 AFR and the 5-10 AFR is 17.1 AFR, my calculated new tuner studio settings is 10.89 AFR @ 0 volts and 19.02 AFR @ 5 volts.



Now if everything was done correctly then now your Megasquirt will be able to read AFR with 1/10th AFR accuracy. Cycle power to Spartan 2 again and now the first 5 seconds AFR should be between 13.3 +/- 0.1 AFR and the 5-10 seconds AFR should be 16.7 AFR +/- 0.1 AFR. Because Megasquirt uses only up to the first decimal place to represent AFR, the best you can do is +/- 0.1 AFR accuracy.

### \*\*\*\* IMPORTANT \*\*\*\*

**Once setup and before any tuning is performed - it is mandatory that the results of the sensor are verified against a known reference**

The Dyno AFR sensor should be sufficient



**Part**

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**IV**

## 4 Reference Install Parts List

MicroSquirt (tm)	
FrankenCIS (tm) Metering Block #1 or #2	
Injector	Delphi FJ10409 Fuel Injector (Single) For Dodge Chrysler Eagle 1993-1997
Control Pressure sensor	100psi Digital 1/8NPT
Pressure Damper if using FrankenCIS #2	Toyota 23270-62010
Gasket for above damper	Toyota 23232-41081
MAP sensor	Denso
IAT sensor	BOSCH 0280130085 , PORSCHE 99360611400 , VW 058905379
Engine Temp sensor	Bosch
WBo2	Innovate LC2 or 14point7 Spartan

(to suit a particular application the last four sensors above can be substituted with anything compatible with MegaSquirt)

Back Cover